GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRICAL ENGINEERING (09)
ELECTRICAL POWER SYSTEM – II
SUBJECT CODE:2160908
B.E. 6thSEMESTER

Type of course: Engineering Science (Electrical)

Prerequisite: Electrical Power System – I

Rationale: NA

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Current and Voltage Relations on a Transmission Line:** Representation of line, The short transmission line, The medium-length line, The long transmission line: Solution of the differential equations, The long transmission line: Interpretation of the equations, The long transmission line: Hyperbolic form of the differential equations, The equivalent circuit of a long line, Power flow through atransmission line (circle diagrams), Reactive compensation of transmission lines.	8	15
2	**Symmetrical Three-Phase Faults:** Transients in RL Series circuits, Short-Circuit currents and the reactances of Synchronous machines, Internal voltages of loaded machines under transient conditions, The bus impedance matrix in fault calculations, A bus impedance matrix equivalent network, The selection of circuit breakers.	8	20
3	**Symmetrical Components:** Synthesis of Unsymmetrical phasors from their symmetrical components, The symmetrical components of unsymmetrical phasors, Phase shift of symmetrical components in Star-Delta Transformer Banks [2], Power in terms of symmetrical components, Sequence circuits of Y and Δ impedances, Sequence circuits of a symmetrical transmission line, Sequence circuits of the synchronous machine, Sequence circuits of a Y- Δ transformer, Unsymmetrical series impedances, Sequence networks	8	15
4	**Unsymmetrical Faults:** Single line to ground fault on an unloaded generator, Line to Line fault on an unloaded generator, Double Line to Ground fault on an unloaded generator, Unsymmetrical faults on power systems, Single line to Ground fault on a power system, Line to Line fault on a power system, Double Line to Ground fault on a power system, Interpretation of the interconnected sequence networks, Analysis of	8	20

	unsymmetrical faults using the bus impedance matrix, Faults through impedance, Computer calculations of fault currents		
5	**Transients in Power Systems:** Transients in Simple Circuits, 3-phase Sudden Short Circuit of an Alternator, The Restriking Voltage after Removal of Short Circuit, Travelling Waves on Transmission Lines, Attenuation of Travelling Waves, Capacitance Switching, Overvoltage due to Arcing Ground.	6	15
6	**Corona:** Critical Disruptive Voltage, Corona Loss, Line Design based on Corona, Disadvantages of Corona, Radio Interference, Inductive interference between Power and Communicationlines.	6	15

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15%	**25%**	**20%**	**20%**	**20%**	**0%**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Power System Analysis : John J. Grainger, William D. Stevenson Jr., Tata McGraw Hill [1,2,3]
2. Elements of Power Systems Analysis : W. D. Stevenson Jr., 4th Edition, McGraw Hill International. [4]
3. Electrical Power systems: C. L .Wadhwa, 5th Edition, New Age International Publishers.[5, 6]
4. Modern Power system Analysis by I J Nagrath, D P Kothari,4th Edition Tata McGraw Hill.
5. Power System Analysis by Hadi Saadat, Tata McGraw Hill.

Course Outcome:

After learning the course the students should be able to:

1. Analyze the performance of Short and Medium transmission line.
2. Describe the symmetrical components and its applications.
3. Analyze Symmetrical and Unsymmetrical faults in power systems.
4. Describe transients in power systems.
5. Describe corona effect.

List of Experiments:

1. To obtain voltage regulation and efficiency of a short transmission line for different specified set of receiving end quantities (different load at leading, unity and lagging power factor).
2. To write computer program for voltage regulation and efficiency of short transmission line for different specified set of receiving end quantities (different load at leading, unity and lagging power factor).

3. To obtain voltage regulation and efficiency of a medium transmission line for different specified set of receiving end quantities (different load at leading, unity and lagging power factor).
4. To write computer program to calculate voltage regulation and efficiency of a Medium transmission line (using π model& T model) for different specified set of receiving end quantities (different load at leading, unity and lagging power factor).
5. To write computer program to calculate voltage regulation and efficiency of a Long transmission line using equivalent π modelfor different specified set of receiving end quantities (different load at leading, unity and lagging power factor).
6. To plot sending end power circle diagram and receiving end power circle diagram of a transmission line on a graph paper with some suitable scale.
7. To simulate transient in series R-L circuit with special attention to change in DC offset current for application of excitation at different instant.
8. To study phase shifting in star- delta transformer with emphasis on the labeling on HV and LV sides. The study should be for positive sequence and negative sequence both.
9. Dynamic simulation of three phase fault on terminal of unloaded synchronous generator. The simulation should show the waveforms of all three line current for fault at different instant on voltage wave of phase A.
10. To analyze L-G fault of a small system (containing generator, transformer and lines) using interconnection of sequence networks.
11. To analyze L- L-G and L- L fault of a small system (containing generators, transformers and lines) using interconnection of sequence network.
12. Calculation of symmetrical components for three to four different set of unbalanced three phase phasors.
13. To write a computer program for obtaining symmetrical components for a given set of unbalanced phasors.
14. Calculation of fault current for a three phase fault in a small power system.
15. To write a computer program for animation of travelling waves of a long transmission line with different operating conditions.

Design based Problems (DP)/Open Ended Problem:

The list of suggested design based problems is as follows:

1. Design of short transmission line for the specified performance parameters and different given load (with power factor).
2. Design of medium transmission line transmission line for the specified performance parameters and different given load (with power factor).
3. Design of long transmission line for the specified performance parameters and different given load (with power factor).
4. Selection of circuit breaker rating (at various buses) for a given small radial feeder for different fault locations and type of faults. The feeder is fed at one end by a voltage source only.
5. Selection of circuit breaker rating (at various buses) for a given small meshed transmission network for different fault locations and type of faults. The network may be fed by some generators.

These problems may be done on paper by hand and/or using some simulation software.

Major Equipment:

MATLAB, C/C++, SciLab

List of Open Source Software/learning website:

http://nptel.iitm.ac.in/coursecontents_elec.php

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.